INDOOR AIR QUALITY ASSESSMENT

Community Action Headstart
Building Two
38 Old Groveland Road
Haverhill-Bradford, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of John Cuneo, Executive Director, Community Action, Inc., an indoor air quality assessment was done at the Bradford Head Start facility in Haverhill, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). The request was prompted by concerns of symptoms believed to be attributed to the building.

On April 16, 2002, a visit was made to this site by Cory Holmes, Environmental Analyst in BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program, to conduct an indoor air quality assessment. Mr. Holmes was accompanied by Richard Lynch, Associate Director for Community Action, Inc.

The Bradford Head Start facility consists of two separate, one-story wooden paneled buildings, which formally served as a day camp. Building two, which is the focus of this report, is approximately twenty years old and contains a classroom, storage and office space. Findings and recommendations for building one are discussed in a separate report.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. Visual inspection for water damage and microbial growth were conducted throughout the building.

Results

The building is occupied four days a week and during school vacations. It is visited by approximately 30 children daily and has a staff of approximately 3. No occupants were present during testing. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from the table that carbon dioxide levels were below 800 parts per million of air (ppm) in all areas surveyed, which typically would suggest adequate fresh air ventilation. It should be noted, however that the assessment was conducted on a day when there were no occupants, which will greatly reduce carbon dioxide levels. It would be expected that carbon dioxide levels would be higher during periods of full occupancy.

No means of mechanical ventilation exist in the building therefore the introduction of fresh air is solely supplied by openable windows. Some areas are equipped with window mounted air conditioners, which do have the capability of introducing fresh air in the "Fan" mode.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this occurs a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix I, which is attached to the Building One report.

Temperature readings ranged from 71 ^{0}F to 72 ^{0}F, which were within BEHA's recommended comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ^{0}F to 78 ^{0}F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in the building was within the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 46 to 48 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Low

relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

BEHA staff examined the outside perimeter of the building to inspect drainage as well as for breaches in the exterior walls and roof (called building envelope), which could provide sources of water penetration.

- The building is not equipped with a gutter/downspout system. Lack of roof drainage may allow rainwater to run down the exterior walls or pool on the ground against the building. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building.
- Several holes in exterior walls of the building were noted (see Pictures 1 & 2), which can provide a source of water penetration as well as a means of entry for rodents/pests.
- Severely water-damaged wood along the eaves of the roof and around window frames was observed (see Picture 3).
- Plant growth was noted on exterior walls (see Pictures 2 & 4). The growth of plants against the exterior walls of the building can bring moisture in contact with building materials. This moisture contact can eventually lead to breaches of the building envelope resulting in water damage and subsequent microbial growth.
- Building occupants report a history of roof leaks in the building. Water damaged flooring, ceiling and wall plaster was observed in several areas (see Pictures 5 & 6), which is evidence of roof or plumbing leaks. Water-damaged building materials can serve as mold growth media, and should be replaced/repaired after a water leak is discovered.

Each of these conditions compromises the integrity of the building envelope and can provide a means for water penetration into the building. Repeated water damage to porous building materials (e.g., wallboard, ceiling tiles, carpeting) can result in microbial growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous building materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed.

Other Concerns

Several other conditions were noted during the assessment, which can affect indoor air quality. Many flying insect nests (e.g., bees, hornets, wasps) were observed around the perimeter of the building. These nests should be removed to prevent potential problems in a manner as to not introduce pesticides and/or insects into the building. BEHA staff observed conditions above the ceiling tiles in the classroom and observed a hole in the exterior wall (see Picture 7) in which flying insects were entering the occupied space. Under current Massachusetts law that went into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in schools (Mass Act, 2000). A copy of the IPM recommendations are included with the Building One report as Appendix II (MDFA, 1996).

The office has a photocopier. Volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). The administrative office is equipped with a local exhaust fan mounted over the window. Office personnel should ensure that local exhaust

ventilation is activated while equipment is in use to help reduce excess heat and odors in this area.

As previously mentioned, some areas contained window-mounted air conditioners. This equipment is normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter.

Conclusions/Recommendations

The conditions noted at the Bradford Community Action Head Start Facility raise a number of indoor air quality issues. Significant areas of the building envelope have been compromised which can lead to water damage and potential microbial growth. The combination of the design, age of the building and lack of maintenance, present conditions that can adversely influence indoor air quality. For these reasons a two-phase approach is required, consisting of **(short-term)** measures to improve air quality and **long-term** measures that will require planning and resources to adequately address overall indoor air quality concerns. In view of the findings at the time of the visits, the following **short-term** recommendations are made:

1. Use windows to introduce outside fresh air. To supplement the use of windows consider operating window mounted air conditioners in the "fan" mode.
2. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water

during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

3. Report any signs of water penetration to building owner/management for prompt remediation.
4. Repair active roof leaks. Once repaired, replace any remaining water-damaged building materials. Examine the areas above and behind these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
5. Seal holes in exterior walls. Replace/repair water damaged building materials. Examine the area around these areas for microbial growth. Disinfect areas of water leaks with an appropriate antimicrobial.
6. Remove plant growths against the exterior wall/foundation of the building to prevent water penetration.
7. Change filters in window-mounted air conditioners as per the manufacturer's instructions to prevent the re-aerosolization of dirt, dust and particulate matter.
8. Activate local exhaust ventilation in office during photocopier use.
9. Use integrated pest management (IPM) practices to remove pests from the building. A copy of the IPM recommendations is included with the Building One report as Appendix II (MDFA, 1996). Activities that can be used to eliminate pest infestation may include the following activities.
    i) Consult a licensed pesticide applicator on the most appropriate method to end infestation.
    ii) Reduction/elimination of pathways (e.g., spaces under doors)/food sources that are attracting pests.

iii) Reduce harborages (plants/cardboard boxes) where pests may reside.

The following **long-term** measures should be considered.

1. Examine the feasibility of installing a gutter/downspout system.
2. Consult with architect and or general contractor regarding water tightness of the building primarily concerning the condition of siding and window frames. Have consultant assess water damaged building materials (e.g., eaves, ceilings, building envelope).

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL.

Mass. Act. 2000. An Act Protecting Children and families from Harmful Pesticides. 2000 Mass Acts c. 85 sec. 6E.

MDFA. 1996. Integrated Pest Management Kit For Building Managers. Massachusetts Department of Food and Agriculture, Pesticide Bureau, Boston, MA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

Picture 1

Hole in Exterior Wall of Building Partially Stuffed with Fiberglass

Picture 2

Hole in Exterior Wall, Also Note Plant Growth on Side of Building

Picture 3

Rotted Wooden Eaves, Note Lack of Gutter/Downspout System

Picture 4

Plant Growth up the Side of the Building

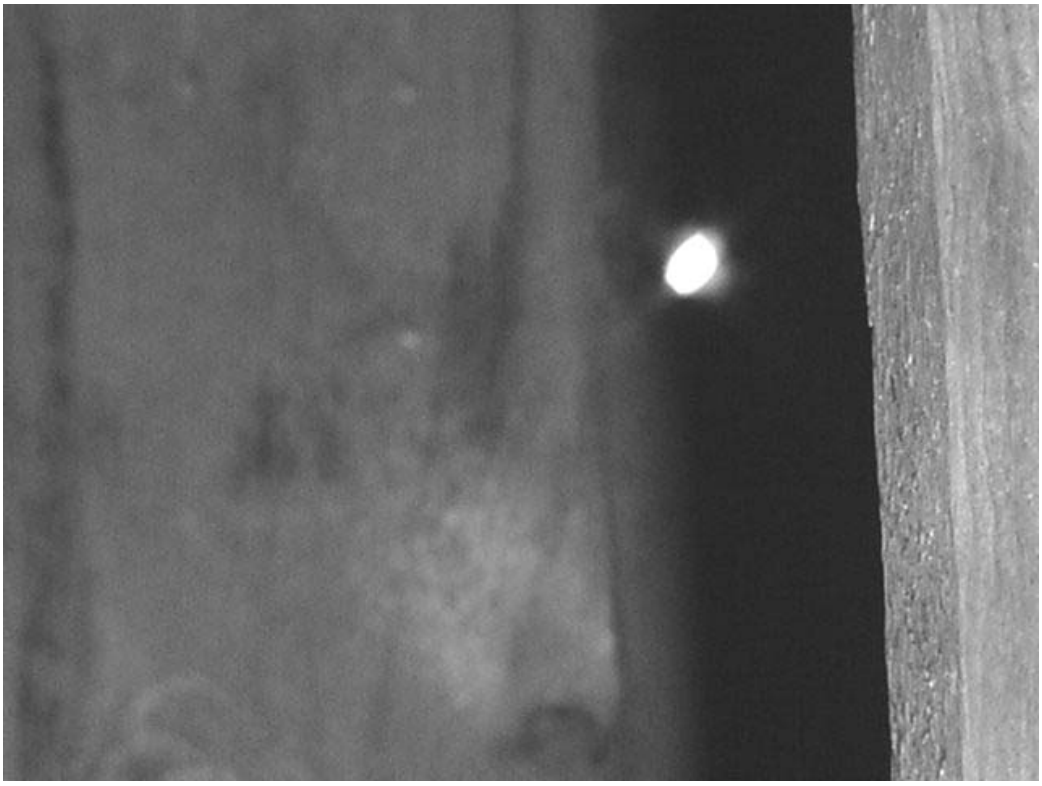
Picture 5

Water Damaged Ceiling Plaster in Classroom

Picture 6

Water Damaged Flooring around Main Entrance

Picture 7



Hole in Ceiling Plenum above Classroom

TABLE 1

Indoor Air Test Results –Haverhill, Bradford Community Action Headstart Facility, Building Two
April 16, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	412	63	60					Weather conditions: Overcast, light breeze
Perimeter Notes								Bees/Wasp's nests, holes in siding, trees/vegetation against building/foundation, rotted/damaged stairwell, no gutter/downspout system
Classroom	435	71	48	0	Y	N	N	Window mounted AC, active roof leaks reported, CT-holes, water damaged CTs, spaces in exterior wall attic-wasps nests, water damaged floor around door
Office	460	72	46	0	Y	N	Y	Local exhaust fan in window, photocopier, water damaged ceiling/walls

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%